At the Policy-Research Interface

Usefulness of Social Network Analysis in Identifying and Selecting Key Stakeholders

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At the Policy-Research Interface: Usefulness of Social Network Analysis in Identifying and Selecting Key Stakeholders

Subject/Problem Educational researchers often aim for informed changes in practice based on their research. But experience tells us that it is not easy for research to affect policy (Fensham, 2009) due to different logics and varieties of discourse. In his article "Speaking Truth to Power with Powerful Results: Impacting Public Awareness and Public Policy" Mack Shelley II (2009) underlines the need for eclecticism in research and its interface with expertise and policy. The goal then, is to establish an interface between research and policy. In this research project the way towards this interface is through finding relevant policy makers – the stakeholders that have an influence on decisions related to research outcomes.

The European research project ASSIST-ME (Assess Inquiry in Science, Technology and Mathematics Education) (www.assistme.ku.dk) is a high-level research project that investigates formative and summative assessment methods to support and improve inquiry-based approaches in European science, technology and mathematics (STM) education. It has as its declared aim to formulate guidelines and recommendations for policy makers, curriculum developers, teacher trainers and other stakeholders in the different European educational systems. This projection of research results is organized through *National Stakeholder Panels* (NSPs) *established to advise and provide professional development on how best to impact policy and practice.* Thus it has been a crucial problem to find an efficacious way of selecting the most relevant persons in the participating countries – rather than just choosing from those that are already known to participating researchers.

Social Network Analysis (SNA) methods have previously been used to describe and facilitate educational change at teacher and school levels (Daly, 2010). Collaborating with partners from the participating countries in ASSIST-ME, we developed and distributed a national survey in each. We applied social network analysis to map out a network of stakeholders in each country and then identified NSP members in each. Following this, partners assembled country's NSPs, and held meetings. Our general interest is to examine the extent to which the SNA method employed in this project has assisted with the creation of NSPs that can make an impact on educational policy in European countries.

Social networks consist of nodes and links representing people and their social connections (Newman, 2010; Wasserman & Faust, 1994). However, the richness of a social relation is reduced when it is represented as a single mathematical object. This could challenge the validity of any selection of stakeholders with impact derived, solely or partially, from SNA. On the other hand, social networks offer a bird's eye view of the structure of a social system, both in terms of who is connected with whom and in terms of quantifiable measures such as size and connectedness. With this paper we focus on this tension between the validity of stakeholder social networks and their structure.

Quantitatively, most social networks have common structures, such as giant components that have paths of connection to most, but not all nodes. Size and the number of connections play a crucial role for the existence of such a giant component (Newman, 2010). Taking the existence of a giant component as a measure of network coherency, and assuming that a coherent network would be more useful than a non-coherent one, we expected useful networks to exhibit a giant component. We also expected a useful network to encompass enough of the science educational scene in a country, and thus have a certain size. We addressed the issue of usefulness by using our collaborating researchers' accounts of meetings with the NSPs to evaluate how many NSP members had been identified through SNA. We also analyzed researcher accounts for their strategies for choosing members to invite to their NSP. Thus, our research question is: What are the relationships between the structure of stakeholder networks and partner researchers' use of networks to select members of NSPs in an international policy-oriented project? We focus on the end composition of the NSPs, but we also use collaborating researcher's written accounts to interpret the results.

Design or Procedure Our goal was to vary the composition of NSPs from country to country depending on the institutions and the individuals responsible for educational change in each. Instead of resorting to traditional sources of known individuals, we developed a method to identify comparable expertise in each culture and to represent different interest spheres (media, policy interests, teacher education and teacher associations, parents' associations, business interests). After each country had assembled their NSP, we validated the method. To facilitate this, we relied on a mixed methods research design (Johnson & Onwuegbuzie, 2004), where qualitative and quantitative methods were used equally throughout the process to inform the design, data collection, and analysis.

We focused on person to person relationships using network mapping to reveal different kinds of connections, pertaining to the influence or impact a stakeholder believes another stakeholder has on local or national levels. The mapping was based on a network survey instrument (Scott & Carrington, 2010) developed for the project in collaboration between each country's researchers. The survey was administered to stakeholder candidates in each country based on lists provided by researchers in each country. To get a more complete network in each country, we also administered the survey to any stakeholders that were named by the candidates on the original list. For each country we used all answers to that country's survey to create the stakeholder network.

For each country we then created an SNA report as a guide for the country researchers in selecting NSP members. In these reports, we identified key stakeholders in the network based on various measures (using the Gephi and R software) of how they were embedded in the network, including images of the network to be used heuristically. In the report, we gave lists of key stakeholders as seen from various quantitative structural perspectives (for example, a person might be in a position that is ideal to connect different parts of the network), but without regard to the interest spheres of the stakeholders.

Researchers in each country used the SNA report combined with their expert knowledge of the educational culture and scene to find a list of key stakeholders from each of the different interest spheres to invite to the NSP. In the following period, each country held an NSP meeting and researchers responsible for selecting the NSP candidates were prompted to account for their choices. From the meeting minutes and researcher accounts, we analysed the composition of the NSPs with regards to both SNA reports and interest spheres.

We analysed the structure of each national stakeholder network in terms of their size relative to the population of that country, the average number of outgoing connections, and the size of the largest connected component of stakeholders relative to the size of the network. In this context, the size of a network is the number of stakeholders present in the network. The average number of outgoing connections is the total number of connections divided by the size. A stakeholder is in a connected component, if it is possible to reach all other stakeholders in that component by following undirected connections from that stakeholder to all other stakeholders in the connected component. The largest of these components in the network is called the largest connected component (Newman, 2010).

To answer the research question, we assumed that researchers that found the SNA reports useful, would have identified and invited many relevant candidates from the lists of key stakeholders. Key stakeholders that accepted the invitation would then be listed as members of the NSP. If the SNA reports were not useful, the NSPs would consist mainly of members not on the key stakeholder lists. To get a fuller understanding of the differences between countries, we relied on the researchers' written accounts.

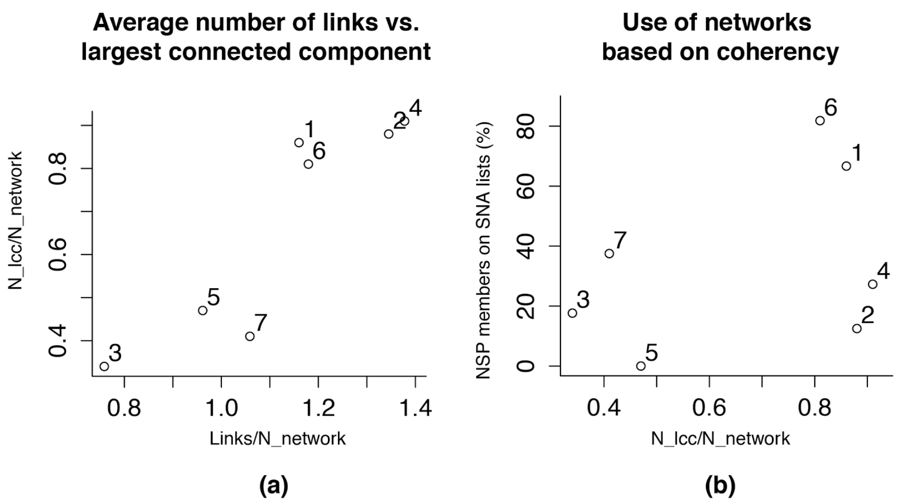

Figure 1. In each panel, the dots and numbers represent different countries. (a) There seem to be a threshold value of the average number of links of about 1.1. (b) The percentage of NSP members that were on the key stakeholder lists in the SNA reports versus the coherence of the network.

Analyses and Findings

From the researcher accounts we know that some preferred to send out to few, but officially important people, while other researchers opted to make extensive lists of potentially relevant stakeholders from all parts of their country. Thus the ratio of candidates relative to country size varied a lot, 25 ± 25 ppm, with large countries having a smaller ratio than smaller countries. We found a Pearson correlation ($r=0.97$, $p<0.001$) between the ratio of candidates relative to country and the size of the resulting network. Due to the small sample size, we regard this correlation (and any of the following correlations) with caution. However, the correlation sums up our experience: Asking just a few of the officially most important people will usually not suffice to produce a large networks, even after two iterations. For large countries, producing initial lists of relevant people that produce large networks will be a challenging task demanding extensive resources. However, seen from an SNA perspective, larger and in this context more encompassing networks are crucial for the method to yield meaningful results (Newman, 2010; Scott & Carrington, 2011).

Figure 1(a) shows how the size of the largest connected component relative to the size of the network is dependent on the average number of links per stakeholder. Interestingly, there seems to be a threshold at about 1.1 Above this value, networks are largely connected, since the largest component includes 80% or more of the stakeholders. Below this threshold, the network consists mostly of isolated islands. The existence of this kind of threshold is predicted from network theory (Newman, 2010). The average number of connections can be seen as a willingness to respond (Author, 2012), and thus we find that it is crucial for the network cohesion that the candidates are willing to name more than one person on average.

Turning to the usefulness of the stakeholder networks, we first investigated if the size of the network made it more useful. We found that network size was Pearson correlated with the number of NSP member that were present in the stakeholder network ($r=0.76$, $p<0.05$). This is meaningful since a larger network has the chance to map out more of the relevant stakeholders. We also observed a roughly growing trend between the size of the network and the percentage of NSP members that came from the key lists of stakeholder in the SNA reports, but we did not find a significant Pearson correlation ($r=0.63$, $p>0.1$). This point resonates well with researcher accounts where we saw different strategies for using the SNA reports in the selection process.

To elaborate on this, Figure 1(b) relates the size of the largest connected component in a country with the percentage of key stakeholders as identified by SNA that made it into the NSPs. Taking the size of the largest connected component as a proxy for network coherency, we identify three distinct groupings: Group 1 (Countries 3,5, and 7), Group 2 (Countries 1 and 6), and Group 3 (Countries 2 and 4). Group 1 has low coherency and low NSP percentage. Group 2 has high coherency and NSP percentage, while Group 3 have high coherency and low NSP percentage. Thus, if the NSP percentage is a measure of usefulness of the SNA reports, then the coherency of the network is not enough to explain variations in usefulness. To appreciate these differences in greater detail we use the accounts from researchers in the seven countries. These show that countries in Group 1 had networks that were biased towards particular communities and that were so disconnected that one could not talk of stakeholders being embedded in a network. This made the networks poor guides for choosing relevant stakeholders. The opposite was true for Group 2, who identified, contacted and successfully recruited a large part of their NSP by actively using the SNA reports. For Group 3, the explanations diverge. In Country 2, the SNA report was used to find relevant stakeholders, but the network showed a lag in comparison with real life. For instance, many people had chosen persons who had held particular employment positions until recently but who had been replaced. Country 2 researchers opted to choose their replacements instead, and the majority (62,5%) of these people were in the stakeholder network. Country 4 had a very coherent network, and the SNA report listed people that the country researchers believed were key stakeholders. Since the network was relatively small there were concerned that it was biased (Scott & Carrington, 2011), and this may have lead to the inclusion of NSP members that were not identified through the SNA report. Group 3 is interesting because they highlight two important limitations of the method: bias of the sample and a knowledge lag in candidate stakeholders.

Contribution In many ways the work with NSPs in ASSIST-ME has just begun and the usefulness of the NSPs cannot be assessed yet. In this paper, we have shared a method for assembling stakeholder panels for political projects and shown how the method can be systematically evaluated. From our analysis, we extract two points:

(1) Resources in proportion to the expected size of the network should be allocated to produce initial lists of relevant candidate stakeholders to ask, since this is likely to yield larger networks. Larger networks have the chance to map out more of the key stakeholders and their connections. Networks also need to be well connected, and we find that the existence of above 1.1 connections per stakeholder is crucial for the overall coherency of the network.

(2) Having performed SNA, researchers will employ different strategies for using the SNA results in their selection processes. These strategies seem to depend on the structure and nature of the stakeholder network. To elaborate on this, we found three groups. Group 1 had disconnected networks that were not useful for assembling the NSPs. Group 2 had coherent networks that were instrumental in assembling their NSPs. Group 3 had coherent networks that highlight two important features of network analysis: bias, which is well-known, and knowledge lag, which we have not encountered before. These findings are valuable to projects wishing to involve stakeholders from science education policy, media, practice areas, and research in changing science education. We believe our results can help other policy oriented projects establish eclectic interfaces between research and policy (Shelley II, 2009). On the other hand, the work with NSPs in ASSIST-ME is far from over, and the usefulness of the NSPs themselves remains to be seen.

<u>General Interest</u> Since many NARST researchers are involved with projects with the potential to influence policy issues at various levels of education, the selection of the best and most relevant policy stakeholders to engage with a project is important. Sometimes these choices are based solely on the knowledge and perspective of the researchers and stakeholders they know. The procedures for using social network analysis employed in this research can increase the relevance of such stakeholder groups. Through iterative network analysis persons who are seen by their peers as having influence over policy at levels from grassroots to ministerial, can be more objectively identified and validated through social network analysis, increasing the chances that research results will have a greater impact.

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